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CANADIAN AGRICULTURAL PARTNERSHIP

NB Forage Variety Evaluation and Management Trials C1819-0246-Y6

Objectives

1. To identify nutrient uptake and removal requirements of legume and grass forage stands at the higher forage yields being obtained and at medium fertility and pH levels.
2. To evaluate the effect of species interaction of Red Clover and Alfalfa (the legumes) with grass species with the potential for higher quality and yield in both complex and simple forage mixtures over the life of a sward.
3. To evaluate the role of annual forage species and cereals (oats, barley, peas, etc.) as a companion or nurse crop.
4. To evaluate numerous plant species for suitability as emergency forage crops on New Brunswick livestock farms.

Summary

A multi activity project was initiated in 2018 to explore challenges associated with alfalfa fertilization, alfalfa stand establishment and the identification of annual crop options that could be used in the event of winterkill events. Numerous events occurred over the 5-yrs of this trial that have impacted this research; personnel changes within DAAF, forage site relocation to Knightville, NB from Richmond Corner, NB, drought in 2020 and Covid-19 Pandemic to name a few. The applicant made every effort possible to complete this work within the original project application despite these challenges.

The results from the alfalfa fertilization activity would indicate that there is no yield response to increased fertilizer rates. What is evident from the results is that in the early productions years of a stand, traditional and proposed fertilizer rates may not replace all the K that is being removed with the crop. These results highlight the need for producers to choose between a sufficiency approach to fertilizer management or a balanced approach. This decision will be impacted by each producer's soil fertility status and the price of fertilizer each year.

The results from the alfalfa establishment activity indicated that alfalfa established better when it was planted with no companion crop or a low rate (50kg/ha) of an annual cereal companion corp. It is believed that insect feeding damage may have thrown the final year's results of this activity off as it resulted in the loss of plants from the better plots. The use of a warm season grass, hybrid Sudangrass in this case, could not be concluded on from this work.

There are several annual crop species and mixtures that could replace a farm's alfalfa stand if it has been lost to a winter kill event. Silage corn provides the most yield per hectare and should be the first choice as an emergency or annual forage crop provided a farm has access to equipment to plant, grow, harvest, store and feed it. Producing the most forage on the least land usually results in the largest return on investment. However, depending on what type of animal is being fed and the specific operation, quality may play a larger part of crop selection.

Conclusion

<u>Plot Scale Assessment of Draft Legume Forage (Alfalfa) Fertility Recommendations</u>

The results from the 3-year data set would indicate that there is no yield response to increased fertilizer rates. What is evident from the results is that in the early productions years of a stand, traditional and

proposed fertilizer rates may not replace all the K that is being removed with the crop. These results highlight the need for producers to choose between a sufficiency approach to fertilizer management or a balanced approach. This decision will be impacted by each producer's soil fertility status and the price of fertilizer in a given year.

Nurse or Companion Forage Crop Evaluation

The results from the alfalfa establishment activity indicated that alfalfa established better when it was planted with no companion crop or a low rate (50kg/ha) of an annual cereal companion crop. It is believed that insect feeding damage may have thrown the final year's results of this activity off as it resulted in the loss of more plants from the better plots. The use of a warm season grass, hybrid Sudangrass in this case, could not be concluded on from this work.

In retrospect, the investigators should maybe have used a Westerwolds ryegrass, a true annual species, in this evaluation.

Emergency or Annual Forage Crop Evaluation

There are several annual crop species and mixtures that could replace a farm's alfalfa stand if it has been lost to a winter kill event. Silage corn provides the most yield per hectare and should be the first choice as an emergency or annual forage crop provided a farm has access to equipment to plant, grow, harvest, store and feed it. Producing the most forage on the least land usually results in the largest return on investment. However, depending on what type of animal is being fed and the specific operation, quality may play a larger part of crop selection.

Amélioration de la durabilité des sols et des cultures au Nouveau-Brunswick C1819-0246-Y6

Objectifs

1. Déterminer les besoins d'absorption et d'élimination des éléments nutritifs des peuplements fourragers de légumineuses et de graminées aux rendements fourragers plus élevés obtenus et à des niveaux de fertilité et de pH moyens.
2. Évaluer l'effet de l'interaction des espèces de trèfle rouge et de luzerne (les légumineuses) avec les espèces de graminées susceptibles d'améliorer la qualité et le rendement des mélanges fourragers simples et complexes pendant la durée de vie d'une prairie.
3. Évaluer le rôle des espèces fourragères annuelles et des céréales (avoine, orge, pois, etc.) en tant que cultures compagnes ou nourricières.
4. Évaluer de nombreuses espèces végétales pour déterminer si elles conviennent comme cultures fourragères d'urgence dans les fermes d'élevage du Nouveau-Brunswick.

Résumé

Un projet à activités multiples a été lancé en 2018 pour explorer les défis associés à la fertilisation de la luzerne, à l'établissement de peuplements de luzerne et à l'identification d'options de cultures annuelles qui pourraient être utilisées en cas de destruction par l'hiver. De nombreux événements se sont produits au cours des cinq années de cet essai et ont eu une incidence sur cette recherche : des changements de personnel au sein du MAAP, le déménagement du site fourrager de Richmond Corner à Knightville (N.-B.), la sécheresse en 2020 et la pandémie de Covid-19, pour n'en nommer que quelques-uns. Le demandeur a fait tout ce qui était en son pouvoir pour mener à bien ce travail dans le cadre de la demande de projet initiale, malgré ces difficultés.

Les résultats de l'activité de fertilisation de la luzerne indiquent qu'il n'y a pas de réaction du rendement à l'augmentation des taux d'engrais. Ce qui ressort des résultats, c'est qu'au cours des premières années de production d'un peuplement, les taux d'engrais traditionnels et proposés peuvent ne pas remplacer tout le K qui est éliminé par la culture. Ces résultats soulignent la nécessité pour les producteurs de choisir entre une approche suffisante de la gestion des engrais et une approche équilibrée. Cette décision sera influencée par l'état de fertilité du sol de chaque producteur et par le prix des engrais chaque année.

Les résultats de l'activité d'établissement de la luzerne ont indiqué que la luzerne s'établissait mieux lorsqu'elle était plantée sans culture compagne ou avec une faible dose (50 kg/ha) d'une culture compagne céréalière annuelle. On pense que les dégâts causés par l'alimentation des insectes ont pu fausser les résultats de la dernière année de cette activité, car ils ont entraîné la perte de plantes dans les meilleures parcelles. L'utilisation d'une graminée de saison chaude, l'hybride Sudangrass dans ce cas, n'a pas pu faire l'objet d'une conclusion dans le cadre de ce travail.

Il existe plusieurs espèces et mélanges de cultures annuelles qui pourraient remplacer le peuplement de luzerne d'une exploitation agricole s'il a été détruit par l'hiver. Le maïs d'ensilage offre le meilleur rendement à l'hectare et devrait être le premier choix comme culture fourragère d'urgence ou annuelle, à condition que l'exploitation ait accès à l'équipement nécessaire pour le planter, le cultiver, le récolter, l'entreposer et le nourrir. Produire le plus de fourrage sur le moins de surface possible permet généralement d'obtenir le meilleur retour sur investissement. Cependant, en fonction du type d'animal nourri et de l'exploitation, la qualité peut jouer un rôle plus important dans le choix des cultures.

Conclusion

Évaluation à l'échelle de la parcelle des recommandations provisoires sur la fertilité des légumineuses fourragères (luzerne)

Les résultats de l'ensemble des données sur trois ans indiquent qu'il n'y a pas de réponse du rendement à l'augmentation des doses d'engrais. Ce qui ressort clairement des résultats, c'est qu'au cours des premières années de production d'un peuplement, les taux d'engrais traditionnels et proposés peuvent ne pas remplacer tout le K qui est retiré de la culture. Ces résultats soulignent la nécessité pour les producteurs de choisir entre une approche suffisante de la gestion des engrais et une approche équilibrée. Cette décision sera influencée par l'état de fertilité du sol de chaque producteur et par le prix des engrais au cours d'une année donnée.

Évaluation des cultures fourragères intermédiaires ou d'accompagnement

Les résultats de l'activité d'établissement de la luzerne ont indiqué que la luzerne s'établissait mieux lorsqu'elle était plantée sans culture compagne ou avec une faible dose (50 kg/ha) d'une culture compagne céréalière annuelle. On pense que les dégâts causés par les insectes ont pu fausser les résultats de la dernière année de cette activité, car ils ont entraîné la perte d'un plus grand nombre de plantes dans les meilleures parcelles. L'utilisation d'une graminée de saison chaude, l'hybride Sudangrass dans ce cas, n'a pas pu faire l'objet d'une conclusion dans le cadre de ce travail.

Rétrospectivement, les chercheurs auraient peut-être dû utiliser un ray-grass de Westerwolds, une véritable espèce annuelle, dans cette évaluation.

Évaluation des cultures fourragères annuelles ou d'urgence

Il existe plusieurs espèces et mélanges de cultures annuelles qui peuvent remplacer le peuplement de luzerne d'une exploitation agricole s'il a été détruit par l'hiver. Le maïs d'ensilage offre le meilleur rendement à l'hectare et devrait être le premier choix comme culture fourragère d'urgence ou annuelle, à condition que l'exploitation ait accès à l'équipement nécessaire pour le planter, le cultiver, le récolter, l'entreposer et le nourrir. Produire le plus de fourrage sur le moins de surface possible permet généralement d'obtenir le meilleur retour sur investissement. Cependant, en fonction du type d'animal nourri et de l'exploitation, la qualité peut jouer un rôle plus important dans le choix des cultures.

Summary:

A multi activity project was initiated in 2018 to explore challenges associated with alfalfa fertilization, alfalfa stand establishment and the identification of annual crop options that could be used in the event of winterkill events. Numerous events occurred over the 5-yrs of this trial that have impacted this research; personnel changes within DAAF, forage site relocation to Knightville, NB from Richmond Corner, NB (Appendix A), drought in 2020 and Covid-19 Pandemic to name a few. The applicant made every effort possible to complete this work within the original project application despite these challenges.

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Introduction:

The management of forage crops has been recognized by the directors of the NBSCIA as being important for the long-term health of the livestock feed industry in the province. Management such as fertilization practices, stand establishment and annual emergency crop options are some of the challenges facing NB farms in relation to producing forage for their operation.

Nutrient management work in forage production has lagged behind other crops for a number of reasons, the main one being that much of the fertility is recycled on farm through manure. Much of the background work to establish fertility requirements was done on soils with very different nutrient levels than farms are working with today. New Brunswick forage fertilization recommendations are based on 2.5 t/ha. Nutrient requirements from other jurisdictions have significantly higher application rates than New Brunswick recommendations, clearly reflecting the increased yield potential of newer forage varieties and mixtures.

In project EARI15-042 "Improved Forage Quality and Quantity through the use of New Mixtures", forage dry matter yields have ranged from a low of 2.5 t/ac to yields of 4.5-5.0 t/ac being more common in a three-cut system. If we consider replacing the P_2O_5 and K_2O removed by a 4.5 t/ac harvest of an Alfalfa forage mixture that amount would be 60 lb/ac of P_2O_5 and 260 lb/ac of K_2O. The current recommendations for a soil with medium levels of P and K are 60 lb/ac of P_2O_5 and 90 lb/ac of K_2O at 2.5

t/ac of expected forage yield. Recommended fertilization levels need to be revaluated under present yield and soil nutrient levels.

Complex forage mixtures sometimes containing a couple of legume species and multiple grass species are being promoted by sales persons in New Brunswick. Meanwhile forage researchers, such as Dr. Dan Undersander at UW and Dr Gerry Cherney at Cornell University are recommending simpler mixtures containing a legume and one or two grass species.

The use of a cereal crop as a companion/nurse crop has been a long-standing practice on many livestock farms in New Brunswick. The idea behind this practice is that the cereal crop competes with weeds early in the growing season and ensures that a decent crop is realized in the establishment year. Some farms would harvest the cereal crop as mature grain and take the straw for use as bedding. Other farms opt to take the cereal crop as silage and depending on the year take a subsequent cut of forage in mid-August. This system can penalize forage production the following year when the cereal crop lodges, grain harvest and/or silage harvest is later than desired for the forage crop to get satisfactory growth going into winter or the cereal crop is seeded at too high a rate. Farms have moved away from the traditional oat or barley companion/nurse crop, to using cereal/peas mixtures, annual ryegrass and even Sudan grass being suggested lately.

The 2018 and 2019 seasons highlighted the importance of "emergency" crop strategies and the importance of annual forage crops to address forage shortages. Management of annual crops or mixtures to re-establish winter failure or compensate for drought and weather extremes caused by global warming will become critical to NB livestock producers.

Project Objectives:

To identify nutrient uptake and removal requirements of legume and grass forage stands at the higher forage yields being obtained and at medium fertility and pH levels.

Plot Scale Assessment of Draft Legume Forage (Alfalfa) Fertility Recommendations

Project leader and collaborators: Ray Carmichael (NBSCIA), Pat Toner, Jason Wells and David Dykstra (NBDAAF).

To evaluate the effect of species interaction of Red Clover and Alfalfa (the legumes) with grass species with the potential for higher quality and yield in both complex and simple forage mixtures over the life of a sward.

Grasses Legume Mixture Evaluation

Project leader and collaborators: Ray Carmichael (NBSCIA)

To evaluate the role of annual forage species and cereals (oats, barley, peas, etc.) as a companion or nurse crop.

Nurse or Companion Forage Crop Evaluation

Project leader and collaborators: Jason Wells (NBDAAF), Ray Carmichael (NBSCIA), Agro-Environmental Club Agrologists, Summer Research Assistants.

To evaluate numerous plant species for suitability as emergency forage crops on New Brunswick livestock farms.

Emergency or Annual Forage Crop Evaluation

Project leader and collaborators: Jason Wells (NBDAAF), Ray Carmichael (NBSCIA), Agro-Environmental Club Agrologists, Summer Research Assistants.

Project Deliverables:

Evaluation of New Brunswick's present fertility requirements of legume and grass forage crops at the higher forage yields being obtained and at medium fertility and pH levels. This will indicate if New Brunswick fertility recommendations need revisions to support the yields that producers are expected to achieve.

Identification of the species interaction in both complex and simple forage mixtures over a production cycle. Red Clover and alfalfa (legumes) and standard grass species as well as some of the newer grass species with the potential for higher quality and yield will be looked at.

Evaluation of the comparative advantage of various annual forage species used as a companion or nurse crop in the establishment year and subsequent production years of alfalfa.

Evaluation of the comparative advantage of various "emergency" annual forage species.

Material and Methods:

Plot Scale Assessment of Draft Legume Forage (Alfalfa) Fertility Recommendations

A yield-based trial for various fertilizer scenarios comparing K_2O additions to removal was conducted at two different locations: in 2019 Richmond Corner and in 2021 and 2022 Knightville. The small plot scale trial was set up as a randomized complete block design (RCBD) using three replicates to determine how well alfalfa yield would respond to a new fertilizer recommendation for increased levels of potassium. Plot size was 1.5m x 6m at the Richmond Corner site, but only 1.5m x 5.5m at the Knightville site due to space availability.

Soil testing prior to treatment application showed soil K levels to be 108 ppm (M+) and 84 ppm (M+) at the Richmond Corner and Knightville sites respectively. These would require fertilizer rates of 68 kg/K2O/ha under our traditional NB recommendations and 110 kg/K2O/ha under proposed ones. A range of fertilizer rates were applied either side of old and proposed recommendation rates in both years with a broader treatment range and follow up soil testing in Knightville.

Nitrogen and phosphorus requirements as outlined in the NB Crop Fertilization Guide were met with a single application of chemical fertilizer in the spring of the year. Potassium applications were done as a split application at the Richmond Corner site, equally split between spring and after first cut. Application rates were adjusted at the Knightville site and allowed for all K2O to be applied as a single spring application. A range of fertilizer rates were applied either side of old and proposed recommendation rates in both years with a broader treatment range and follow up soil testing in Knightville. The rates used at the Richmond Corner site were 0, 150 and 300 kg K_2O/ha while the rates at the Knightville site were 0, 50, 100, 150 and 200 kg K_2O/ha. At the Knightville site, treatments were applied to the same plots in 2021 and 2022. Muriate of Potash (0-0-60) was the product used.

Plots were harvested with a Haldrup plot harvester and a sample was retained for forage quality analysis. The forage quality analysis was completed at the PEI Analytical Lab in 2019 and at A&L Labs in 2021 and 2022.

All data was tabulated in Excel and statistics were run.

Grasses Legume Mixture Evaluation

The exceptionally dry climactic conditions at the Richmond Corner site during the 2019 growing season had a negative impact on establishment for all mixtures and species. Since most of the forage work was being moved to a new site in Knightville, NB in 2020, these plots were abandoned. The Covid-19 pandemic created numerous challenges with the establishment of the new forage site. It was not possible to properly prepare the site to accommodate perennial forage mixtures containing alfalfa (i.e. alfalfa autoxicity). The focus was placed on other components of this project that were able to be established and bring useable info to producers in a timely fashion. Additional species/plots were added to the Emergency or Annual Forage Crop Evaluation component of this project, with some being mixtures with clover. Any notable results related to mixtures with legumes will be made in that section.

Nurse or Companion Forage Crop Evaluation

A small plot scale trial was set up as a randomized complete block design (RCBD) using three replicates (Appendix B). Plot size measured 1.5m x 6m. Plots were seeded June 21, 2020.

Plots were harvested 30 days post seeding with a Haldrup plot harvester. Samples were retained for forage quality analysis. Due to the drought like conditions in 2020, only one harvest was taken in the establishment year.

Plots were not reseeded in 2021 or 2022 but were maintained as pure stands of alfalfa that had been planted along with the companion crop originally. Plots were fertilized and maintained using standard farmer practices in 2021 and 2022 with two cuts occurring each season. Samples were again retained for forage quality analysis.

Plant counts were performed on all treatments in the fall of 2020, spring of 2021 and spring of 2022 using a $0.25m^2$ at three random locations per plot.

The forage quality analysis was completed at A&L Labs by NIR using their Milk 2006 analysis package.

All data was tabulated in Excel and statistics were run.

Emergency or Annual Forage Crop Evaluation

A small plot scale trial was set up as a randomized complete block design (RCBD) using three replicates. Plot size measured 1.5m x 6m. Plots were seeded yearly since most species or mixtures evaluated were annual in nature. The crops seeded varied from year to year based on results of previous years (Table 1).

Table 1. Species Planted Each Year

Crop	2019	2020	2021	2022
	Richmond Corner	---- Knightville ----		
Cool Season Annuals				
Oats	x			
50/50 Oats&Peas	x	x	x	x
Silo Buster		x	x	x
50/50 Oats&Peas + Annual Ryegrass				
Annual Ryegrass	x			X
Forage Peas	x			
Winter Cereal Rye (spring planted)		x		
Winter Cereal Rye + Red Clover (spring planted)		x		
Winter Cereal Rye (fall planted)		x		
Winter Triticale (fall planted)		x		
Winter Triticale + Balansia Clover (fall planted)		x		
Forage Soybeans	x	x	x	x
Warm Season Annuals				
Sorghum-Sudangrass	x	x	x	x
Sorghum-Sudangrass Mix*			x	x
Forage Sorghum			x	x
Hybrid Sudangrass		x		
Hybrid Pearl Millet		x	x	x
Canadin Forage Pearl Millet	x		x	x
Japanese Millet			x	x
Berseem Clover	x	x		
Teff	x	x	x	
Silage Corn	x	x	x	x

* Sorghum-Sudangrass + Annual Ryegrass + Crimson, Berseem, Balansia and Double Cut Red Clovers

Plots were harvested with a Haldrup plot harvester at the appropriate maturity stage for each crop. If a given crop could provide multiple cuts, they were taken according to a standard farm harvest schedule. Samples were retained for forage quality analysis.

The forage quality analysis was completed at A&L Labs by NIR using their Milk 2006 analysis package.

All data was tabulated in Excel and statistics were run.

Results and Discussion:

Plot Scale Assessment of Draft Legume Forage (Alfalfa) Fertility Recommendations

A summary of the dry matter yield seen across all cuts in the three seasons is shown in Table 2. 2019 results would imply no differences cut to cut, with the season total increasing with the rate of potassium. In 2021, the yield appeared to be higher in the treatment that applied 127 kg K/ha (approximately 150 kg/K2O/ha) in the first cut. This same trend was seen again in 2022 but only slightly. However, the season totals in 2021 and 2022 do not show the trend seen at the Richmond Corner site, with yields staying relatively stable at the various treatment levels.

Seasonal K uptake followed a similar trend to yield at both sites and in all years (Table 3). At the Knightville site, K uptake exceeded the K rate applied in all treatments except the highest rate of K addition in 2022. It is suspected that if the trial was continued the soil K levels could decline over time.

In season soil testing was conducted at the Knightville site in 2021 and 2022 using a composite of the plots by treatment. In 2021 a significantly higher soil test level of potassium was seen in the 127 kg K/ha treatment (Table 4) and may have resulted in the higher yield seen in the first cut. This elevated soil K level was not seen in this treatment in 2022 and is likely just from the variability associated with using a composite soil sample. It can be seen from the soil data in Table 3, that soil K levels dip slightly in the second year of the trial for all treatments except the 169 kg K/ha rate. This shows that fertilizing at levels lower than crop uptake will draw down soil K levels over time.

Table 2. Dry Matter Yield

treatment kg K/ha	cut 1 dm yield t/ha	cut 2 dm yield t/ha	cut 3 dm yield t/ha	seasonal dm yield t/ha
Richmond Corner 2019				
0	3.2	2.1	1.2	6.5
125	3.1	2.3	1.2	6.6
250	3.5	2.6	1.2	7.3
p-value	0.065	0.059	0.956	0.035
Knightville 2021				
0	5.1	3.5	-	8.7
42	4.8	3.5	-	8.3
84	4.8	3.3	-	8.2
127	5.6	3.3	-	8.9
169	5.1	3.3	-	8.4
p-value	0.024	0.679		0.114
Knightville 2022				
0	4.8	3.0	-	7.8
42	4.8	2.8	-	7.6
84	4.6	2.8	-	7.5
127	5.2	2.6	-	7.8
169	5.0	2.6	-	7.6
p-value	0.519	0.482	-	0.955

to convert kg K/ha to kg K2O/ha multiply by 1.2

Table 3. K Uptake Data

treatment	cut 1 K uptake	cut 2 K uptake	cut 3 K uptake	seasonal K uptake
kg K/ha	kg K/ha	kg K/ha	kg K/ha	kg K/ha
Richmond Corner 2019				
0	40	48	17	104
125	47	63	17	127
250	61	59	20	139
p-value	0.451	0.660	0.375	0.286
Knightville 2021				
0	129	67	-	196
42	119	68	-	188
84	119	66	-	185
127	135	68	-	204
169	127	68	-	194
p-value	0.392	0.990	-	0.498
Knightville 2022				
0	98	64	-	161
42	104	56	-	160
84	100	56	-	157
127	113	55	-	167
169	110	52	-	162
p-value	0.355	0.655	-	0.947

to convert kg K/ha to kg K2O/ha multiply by 1.2

Table 4. Soil K Levels

	Knightville 2021		Knightville 2022	
treatment kg K/ha	soil K level (ppm)	soil K rating (ppm)	soil K (ppm)	soil K rating (ppm)
0	73	M	66	M
42	99	M+	67	M
84	78	M+	73	M
127	170	H+	83	M+
169	87	M+	93	M+

Nurse or Companion Forage Crop Evaluation

The dry climactic conditions during the 2020 growing season impacted the establishment and performance of all combinations, but fortunately establishment was satisfactory and trial work could continue.

Plant counts in the spring of the first production year showed more alfalfa plants were present when alfalfa was planted with no companion crop (Figure 1). The number of alfalfa plants in plots that had used either a low rate of oats or a low rate of oats and peas as the companion crop were less than the no companion crop treatment but were not statistically different from it. Only the no companion crop treatment and the low oat treatment had the required number of plants needed to be considered a healthy first production year stand (32-54 plants/0.25m^2). By 2022, the second production year, plant numbers had trailed off in all plots (Figure 1) with no treatment having enough plants to be considered a viable second production year stand (21-32 plants/0.25m^2).

In the fall of 2021 winter cutworm (the caterpillar, or larva, of the greater yellow underwing moth), *Noctua pronuba*, was found at the site (Figure 2). It is speculated that feeding from the insect during the critical fall rest period of alfalfa or throughout the winter may have impacted the winter survival of the crop and resulted in low plant counts in the spring of 2022.

Cumulative yield results are graphically presented in Figure 3. When alfalfa was planted alone (no companion crop) or a low rate of a companion crop was used, the cumulative 3-yr dry matter yield tended to be higher than when medium or high rates of a companion crop was used.

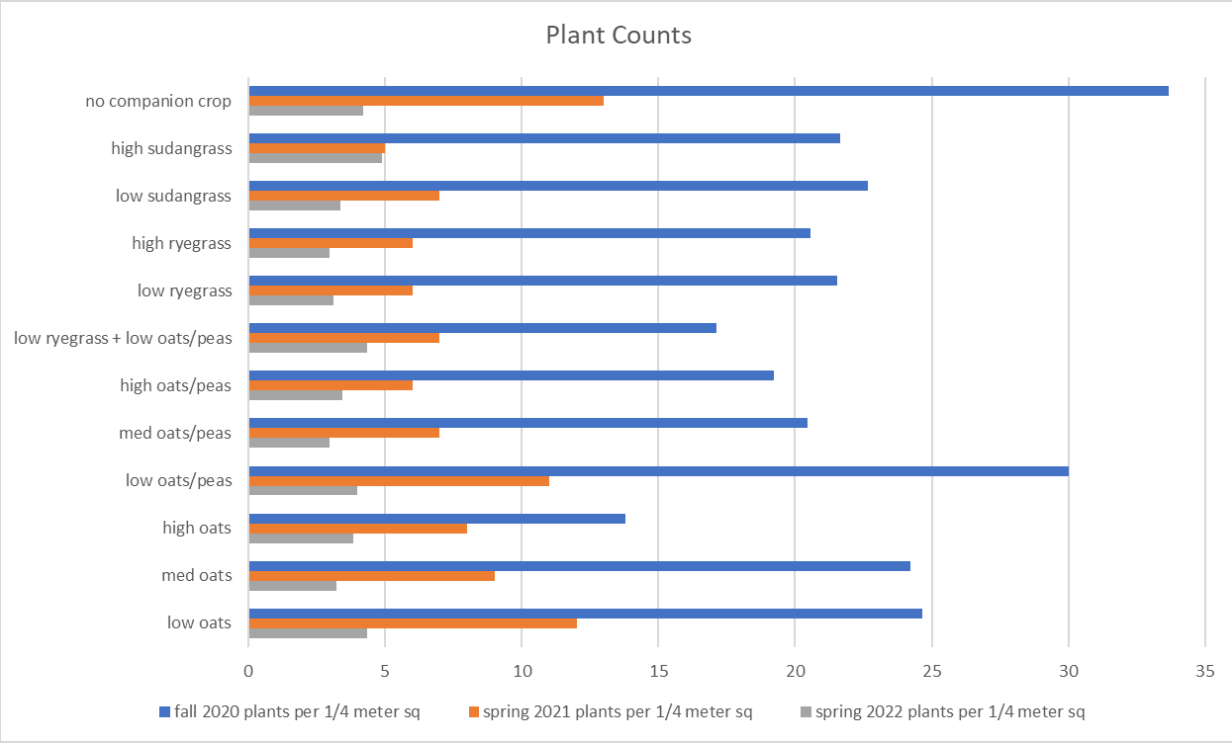


Figure 1. Plant Counts the Fall of the Establishment Year and Spring of Each Production Year

Figure 2. Winter Cutworm and Plant Damage

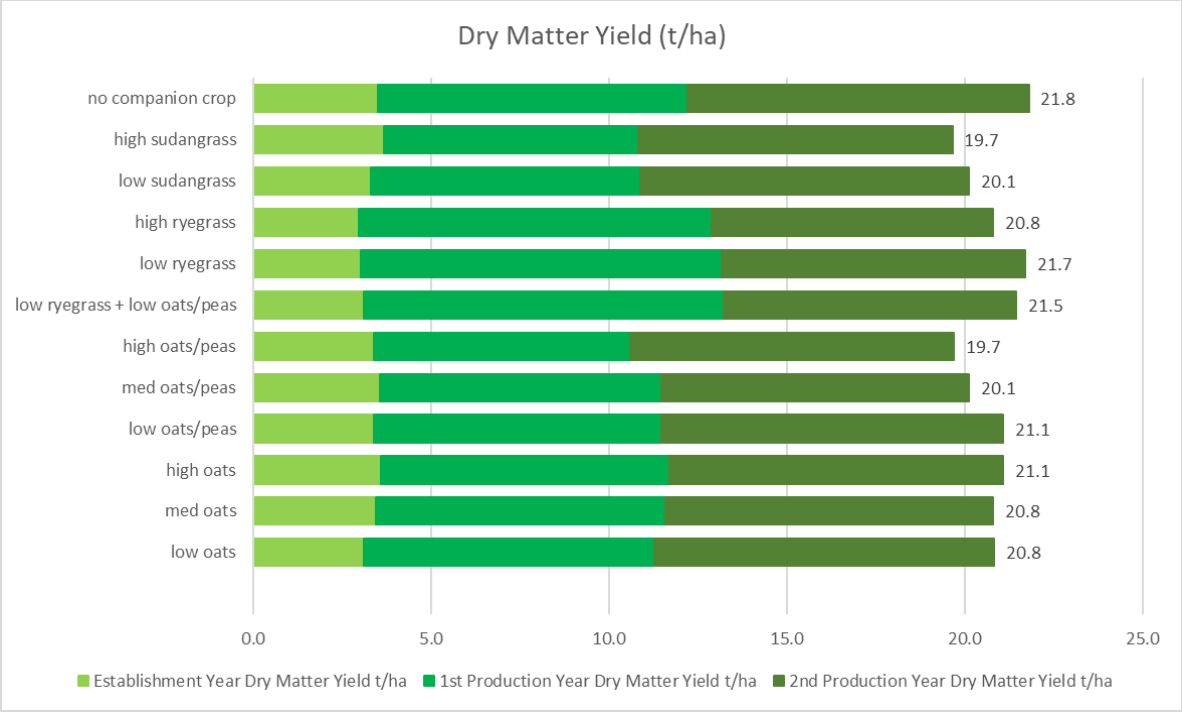


Figure 3. Cumulative Dry Matter Yield (t/ha)

The data in the first production year is a bit skewed due to the survival of the annual ryegrass that had been used as or part of a companion crop. This was not expected as annual ryegrass generally does not survive our winters. However, it should be noted that an Italian type ryegrass was used in this trial, which in more milder climates can be a biannual. The winter of 2020 was obviously mild enough for it to survive.

In the second production year plots that had used annual ryegrass as or part of a companion crop in the year of seeding had lower dry matter yields compared to the other plots. Since the Italian ryegrass is a biannual, it wasn't present by the second production year to contribute to yield. It is suspected that the competition it had created with the alfalfa in the establishment and first production years may have resulted in this reduced yield.

Winter cutworm damage may have also impacted the dry matter yield in the second production year. Since all plots had virtually the same number of plants in them it stands to reason that the yield would be similar.

Emergency or Annual Forage Crop Evaluation

Figure 4 illustrates the differences in seasonal dry matter yield per hectare between the crops grown in 2022. Seasonal dry matter yield data for the other crop years are presented in Appendix C since they were previously discussed in interim reports. Statistical significance is indicated on the figure

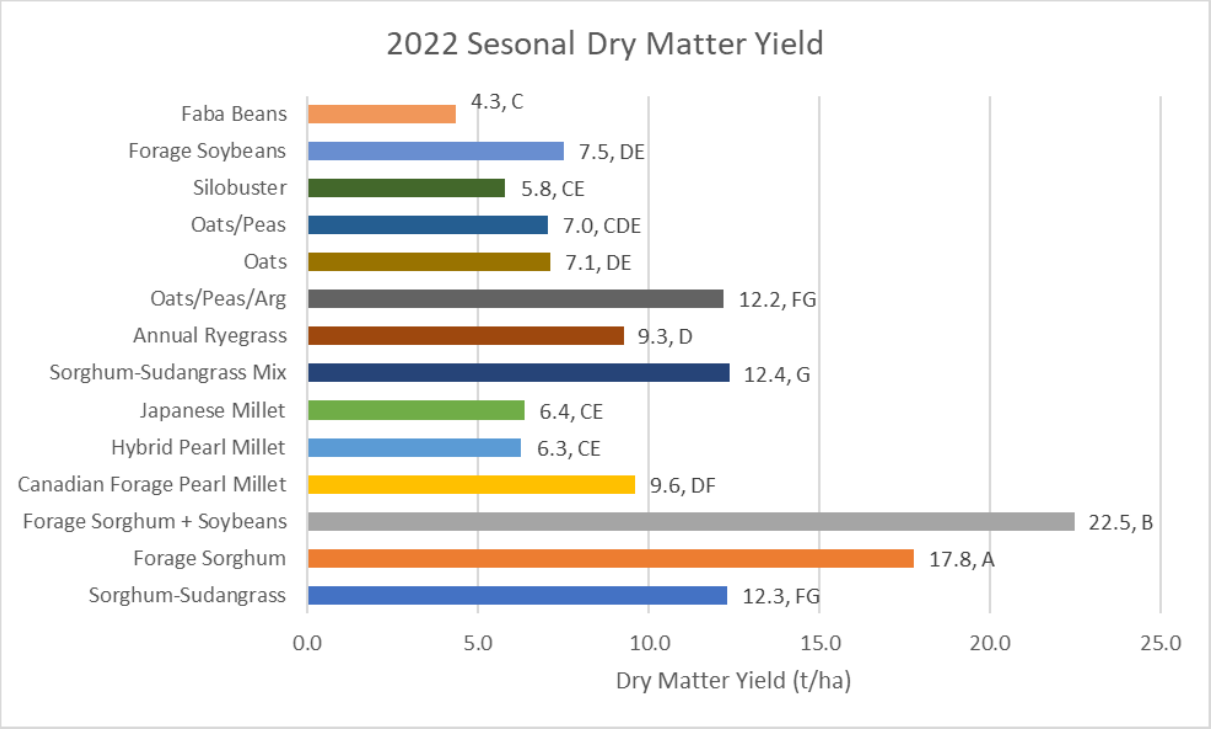


Figure 4. 2022 Seasonal Dry Matter Yield of Various Annual Crops Grown (t/ha)

by letters. Depending on crop, the seasonal yield could be multiple cuts added together to produce the seasonal total.

Faba Beans had the lowest yield of all the crops planted in 2022. It is felt that poor establishment due to seed bed preparation was the main factor. The crop was also stressed by hot temperatures received at the end of July and into August; visually the crop did not look healthy at the time of harvest. This option is known to work in cooler climates (ex. Newfoundland) and would need to be tried again before it could be fully discounted in New Brunswick.

Forage sorghum planted with forage soybeans had the highest yield of all the crops planted, followed by forage sorghum planted alone. Harvest occurred on September 29, with both crops coming off close to 30% dry matter. Luckily it was a long warm fall without frost to allow the forage sorghum to head out and mature to this point on its own. The difference in yield between these two is intriguing since at harvest time there was little to no forage soybeans present in the mixed plot to contribute to the yield. The soybean component of the mix did germinate and begin to grow but must have died out during the growing season. It is possible that the soybeans contributed some nitrogen to the system which the forage sorghum was able to turn in to additional yield.

Oats, peas and annual ryegrass seeded in combination and the Sorghum-Sudangrass Mix were in the middle of the pack for yield. It is important to keep in mind that these combinations required 3 and 2 cuts, respectively to obtain the amount of yield reported in Figure 4. Every additional harvest timing would drive up the costs associated with a crop, potentially making it uneconomical. The suitability of any crop is ultimately determined by the forage production system available on the farm.

Forage quality parameters were assessed for first, second and third (if applicable) cuttings. Only the results for 2022 seasonal milk yield are reported here (Figure 5). Seasonal milk yield combines the milk per tonne (MPT) index and dry matter yield into one term. The MPT index was introduced by Undersander et al. (1993) and uses forage analyses (crude protein, NDF, *in vitro* NDF digestibility, and non-fiber carbohydrate) to estimate energy content using a modification of the NRC (2001) summative approach and DM intake from NDF (Mertens, 1987) and *in vitro* NDF digestibility (Oba and Allen, 1999) to predict milk production per tonne of forage DM.

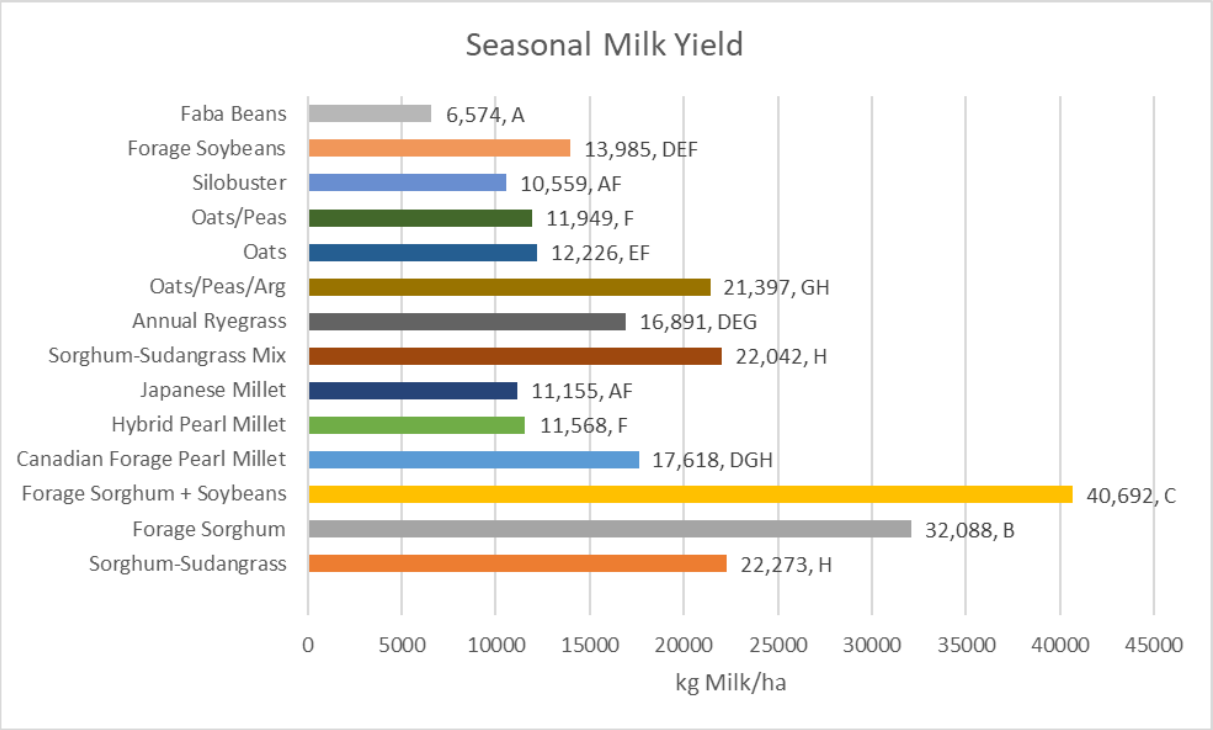


Figure 5. Seasonal Milk Yield

Producing the most forage on the least land usually results in the largest return on investment. However, depending on what type of animal is being fed and the specific operation, quality may play a larger part of crop selection. Figure 5 reports the seasonal milk yield for all the crops grown in this trial. Estimated milk yield per hectare of the crops followed the same trend as yield.

Seasonal dry matter yields for crops that had multiple years of testing are shown in Figure 6. Seasonal dry matter yields for Alfalfa (2-yrs) and Silage Corn (3-yrs) are shown for comparison purposes. Unfortunately, Alfalfa was not harvested at the site in 2020 to compare yields to in that year. In 2021, sorghum-sudangrass, hybrid pearl millet, oats and peas, forage soybeans and forage sorghum would have replaced the dry matter yield obtained from Alfalfa if a winter kill event had occurred. In 2022 only sorghum-sudangrass and forage sorghum would have replaced the yield lost to winter kill. Silage Corn would have more than replaced the yield needed in all 3-yrs and then some; especially the drought year of 2020. Provided a farm has access to equipment to plant, grow, harvest, store and feed Corn Silage, it should be the first choice as an emergency or annual forage crop.

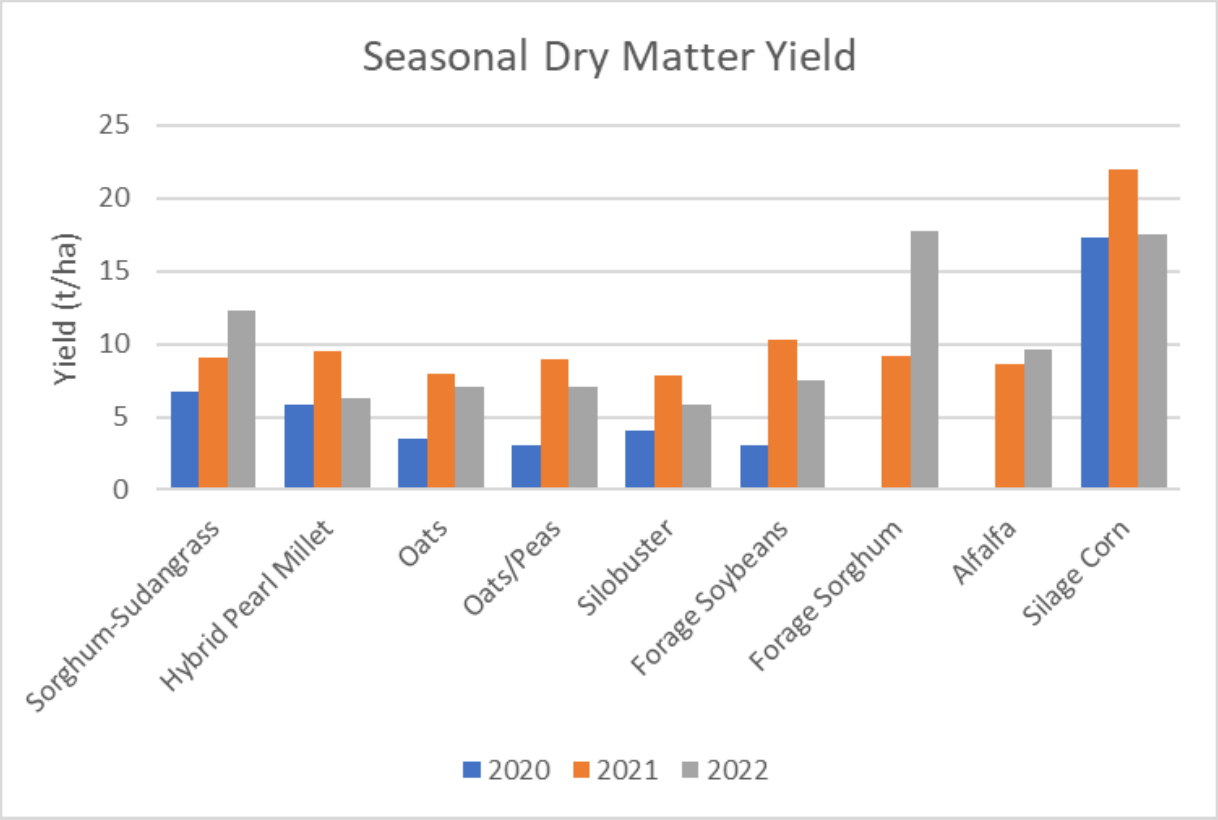


Figure 6. Seasonal Dry Matter Yield for Multiple Years (t/ha)

Conclusions:

Plot Scale Assessment of Draft Legume Forage (Alfalfa) Fertility Recommendations

The results from the 3-year data set would indicate that there is no yield response to increased fertilizer rates. What is evident from the results is that in the early productions years of a stand, traditional and proposed fertilizer rates may not replace all the K that is being removed with the crop. These results highlight the need for producers to choose between a sufficiency approach to fertilizer management or a balanced approach. This decision will be impacted by each producer's soil fertility status and the price of fertilizer in a given year.

Nurse or Companion Forage Crop Evaluation

The results from the alfalfa establishment activity indicated that alfalfa established better when it was planted with no companion crop or a low rate (50kg/ha) of an annual cereal companion corp. It is believed that insect feeding damage may have thrown the final year's results of this activity off as it resulted in the loss of more plants from the better plots. The use of a warm season grass, hybrid Sudangrass in this case, could not be concluded on from this work.

In retrospect, the investigators should maybe have used a Westerwolds ryegrass, a true annual species, in this evaluation.

Emergency or Annual Forage Crop Evaluation

There are several annual crop species and mixtures that could replace a farm's alfalfa stand if it has been lost to a winter kill event. However, silage corn provides the most yield per hectare and should be the first choice as an emergency or annual forage crop provided a farm has access to equipment to plant, grow, harvest, store and feed it.

Producing the most forage on the least land usually results in the largest return on investment. However, depending on what type of animal is being fed and the specific operation, quality may play a larger part of crop selection.

There are several annual crop species and mixtures that could replace a farm's alfalfa stand if it has been lost to a winter kill event. Silage corn provides the most yield per hectare and should be the first choice as an emergency or annual forage crop provided a farm has access to equipment to plant, grow, harvest, store and feed it. Producing the most forage on the least land usually results in the largest return on investment. However, depending on what type of animal is being fed and the specific operation, quality may play a larger part of crop selection.

Required Next Steps:

None.

Communication:

Various field days were held during the 5-yrs of this trial. Multiple interim reports have been submitted. Results have been presented in various NBSCIA newsletters and annual reports. Results have been presented virtually and in-person at various NBSCIA meetings. Results and work are discussed during farm visits.

Appendix A

Knightville Forage Site

Appendix B

Nurse Crop Plot Layout and Seeding Rates

Rep 1		Rep 2		Rep 3
Guard		Guard		Guard
Medium Oats/Peas (80kg/ha)		Low Sudangrass (15kg/ha)		Medium Oats/Peas (80kg/ha)
No Companion Crop		High Sudangrass (20kg/ha)		High Sudangrass (20kg/ha)
Low Ryegrass + Low Oats/Peas (5kg/ha + 55kg/ha)		Medium Oats (80kg/ha)		High Oats (135kg/ha)
Low Oats/Peas (55kg/ha)		Low Ryegrass (5kg/ha)		Low Ryegrass + Low Oats/Peas (5kg/ha + 55kg/ha)
High Oats/Peas (160kg/ha)	Pathway	Medium Oats/Peas (80kg/ha)	Pathway	Low Oats (55kg/ha)
Low Ryegrass (5kg/ha)		High Ryegrass (10kg/ha)		Low Sudangrass (15kg/ha)
Low Oats (55kg/ha)		Low Oats (55kg/ha)		Low Ryegrass (5kg/ha)
Low Sudangrass (15kg/ha)		No Companion Crop		Medium Oats (80kg/ha)
High Sudangrass (20kg/ha)		Low Oats/Peas (55kg/ha)		High Ryegrass (10kg/ha)
High Oats (135kg/ha)		High Oats/Peas (160kg/ha)		High Oats/Peas (160kg/ha)
Medium Oats (80kg/ha)		High Oats (135kg/ha)		Low Oats/Peas (55kg/ha)
High Ryegrass (10kg/ha)		Low Ryegrass + Low Oats/Peas (5kg/ha + 55kg/ha)		No Companion Crop
Guard		Guard		Guard

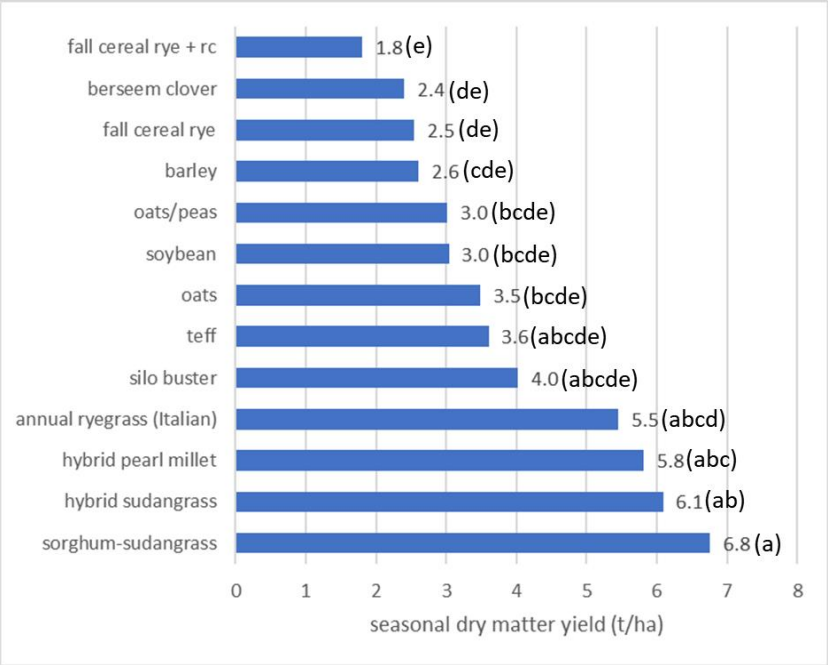
Appendix C

Emergency or Annual Forage Dry Matter Yields by Year

2019 Richmond Corner Results

Synthèse (Moyennes estimées) - Specie :	
Species/Mixture	DM (T/ha)
Corn Silage	10.5a
Soybean Silage	2.5b
Oat/Pea	2.2bc
Oats	2.1bcd
Peas	1.4bcde
Sorghum Sudan	1.0cde
Berseem clover	0.9cde
Tef	0.8de
Pearl Millet	0.8de
Italian ryegrass	0.5e
Pr > F(Modèle)	< 0,0001
Significatif	Oui

2020 Knightville Results



2021 Knightville Results